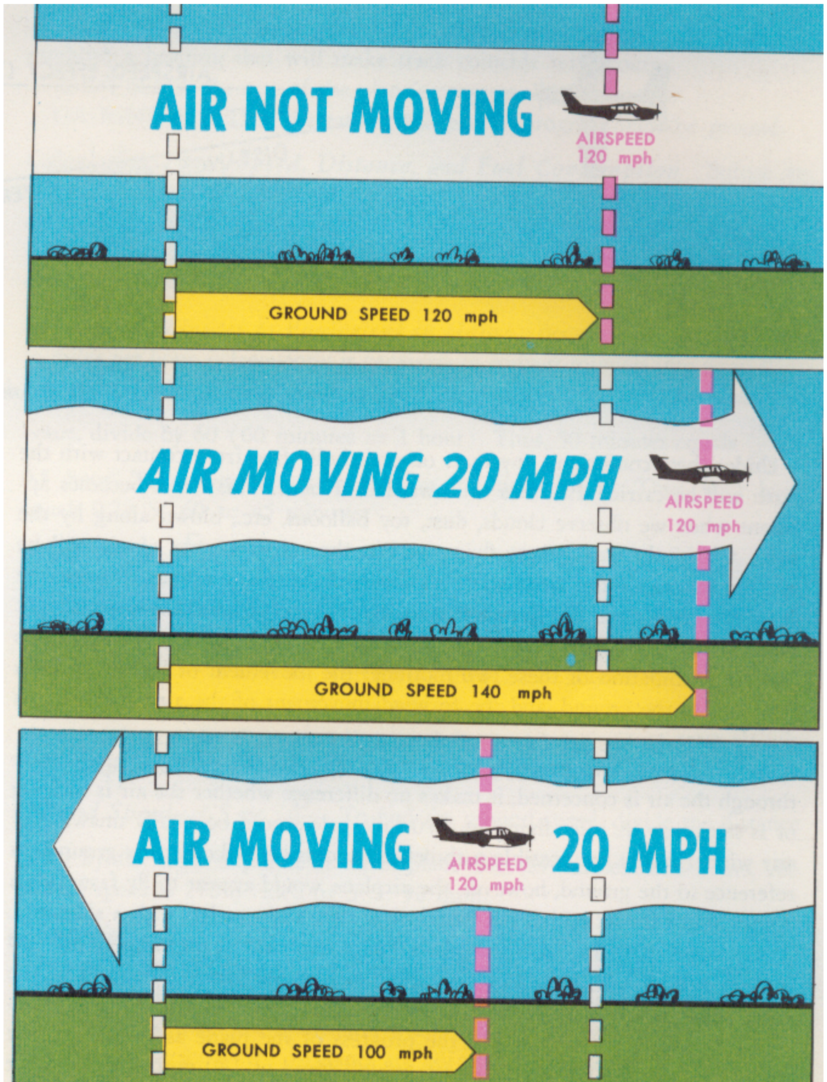


Figure 74. *Motion of the air affects the speed with which airplanes move over the earth's surface. Airspeed, the rate at which a plane moves through the air, is not affected by air motion.*

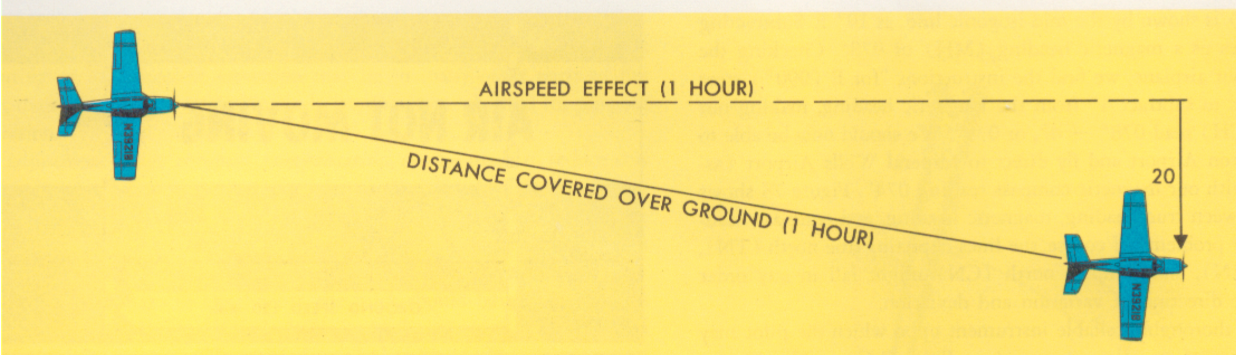
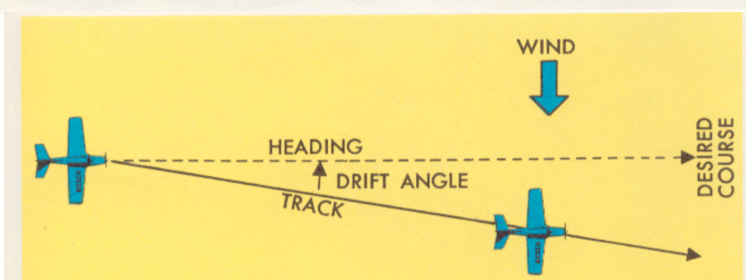


Figure 75. *Airplane flight path resulting from its airspeed and direction, and the wind speed and direction.*



Box and Whiskers Graphs

Box and Whiskers graphs are a simple, linear way to analyze sets of continuous numerical data. They are especially helpful in determining whether or not there are significant differences between sets of data. I teach this technique to ALL my students early in the year, and they use it to analyze all sorts of data quickly and efficiently. The following description will "walk you through" the way I teach this method of analysis to my students. Then, there is a brief description of some possible applications and highlights of this method.

1. Students are given a piece of paper with rows of "o's" on it like this:

```
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
ooooooooooooooo
```

   They are instructed to use their dominant hand to write "x's" in as many of the "o's" as they can in ten seconds.

2. Each student counts how many "x's" they have written, and this data is tabulated on the board. The table is then rewritten so the data appear in RANK ORDER from lowest to highest.

   SAMPLE DATA 1:

   20, 23, 23, 24 27,27 30 34 40

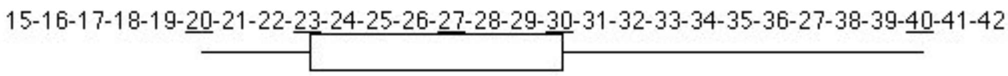
3. Five important data points are identified:

The LOW VALUE (LV)	20
The HIGH VALUE (HV)	40
The MEDIAN (middle value) (M)	27
The LOWER QUARTILE (LQ) (the median value between the low value and the whole-set median)	23
The UPPER QUARTILE (UQ) (the median value between the high value and the whole-set median)	30

4. Draw a number line that spans all the values and plot each of the five points identified in step three:

   19-**20** -21-22-**23** -24-25-26-**27** -28-29-**30** -31-32-33-34-35-36-27-38-39-**40** -41-42

5. Draw a "BOX" from the lower quartile to the upper quartile through the median, and then draw "WHISKERS" that extend from the ends of the box to the high and low values:

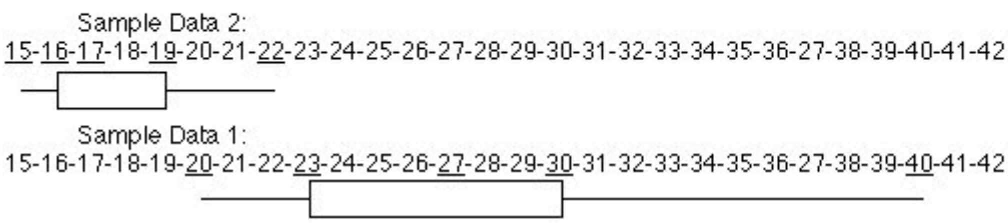


6. Students repeat the exercise of filling in "o's", this time using their NON-dominant hand. The new data are tabulated in rank order and the LV, HV, M, LQ and UQ are identified:

   SAMPLE DATA 2:

   15
   15
   16 LV=15
   16 HV=22
   17 M= 17
   18 LQ=16
   19 UQ=19
   20
   22

7. A new box and whiskers plot is constructed, using the same scale so the two plots can be aligned vertically:



8. The following conclusions can be drawn from this analysis:

   a. The "BOX" from data set 2 does NOT overlap the "BOX" from data set one. Therefore, the differences between these two sets of data are likely to be significant (NOT due to random chance). If the boxes DID overlap (to any degree), then the two sets of data are not significantly different.

   b. The "BOX" from set 2 is smaller than the "BOX" for set 1. Therefore, there is less variability in set 2 than in set 1.

This technique can be used to analyze virtually any type of continuous numerical data. Often, students see that the "BOX" is quite wide, indicating highly variable data, and this observation leads them to compare variability. Once they figure out how to make these graphs, my students use them all the time, and I find that their ability to interpret data and draw logical conclusions improves rapidly. Many thanks to Steve Randak Gen Nelson for showing me this technique!

REFERENCE:
Landwehr, J.M. and Watkins, A.E., *Exploring Data* , Dale Seymour Publications
ISBN-0-86651-312-3
Dale Seymour Publications
P. O. Box 10888
Palo Alto, CA 94303

Distance+RateX Time

Laura knows that the plane has enough fuel to fly to Annapolis, but if she needs to fly until the fuel tank is empty, to avoid a fiery crash, how far should she fly? A quick glance at the map gives her an idea: If the distance between two cities can be compared with a third city, a triangle could be drawn and the distances calculated accurately using Pythagoras's theorem. (Laura is a smartie when it comes to math.) She happens to have her calculator with her. She knows from the flight plan that Jerry was planning to fly at 120 knots per hour, but she does not know the distance between Toronto and Annapolis. Using a scale of 1inch equals 100 miles, the map gives a distance of almost exactly 300 miles to Syracuse, NY., and about 400 miles from Syracuse to Annapolis. Substituting the distances in the formula A square plus B square =C square, Laura finds that 900 + 1600 = 2500. The distance for the direct flight between Toronto and Annapolis must be the square root of 2500, or 500 miles.

The question is, if the pilot indicated enough fuel to fly for seven hours and thirty minutes, how much more fuel would be used up by flying to Syracuse and then Annapolis? The distance for that route is about 200 miles further. (300 + 400 = 700, minus 200 = 500.)

Using the Distance, time and rate formula, Laura needs to calculate the rate of fuel comsumption based on the pilot's statement on the flight plan. 5 hrs. 40 minutes of flying time would have left fuel for another hour and fifty minutes of flying. Will there be sufficient fuel to fly the Syracuse route?

Answer: Convert both times to minutes. Set up the problem using the formula with the known quantities. D=RT. 500 = R X 5(60) + 40 minutes

500 = R X 300 + 40:

500 = 340R

500/340 = R

So R = 1.47

Dividing 200 miles by the rate of 1.47, it should take 136 minutes to fly the extra distance. There is extra fuel for one hour and fifty minutes, a total of 130, so the travel time will not allow the trip to be made with the available gas. The challenge is to find another route that will work.
Solution: fly out over the water from Baltimore, and the fuel should run out on the way to Annapolis.

Incident Report
Instructions: Use this form to report emergency situations

Time: __________ Date: __________________

Location:____

Person in charge at scene: ____

Actions taken:

Observations:

Equipment deployed:

Comments:

Submitted by:

Table 1: Nine Possible Landing Sites Depending on Combined Wind Speed and Wind Direction Effects

Assuming a Flight Originating in Toronto, Ontario, Canada (43° 37’ N / 79° 23’ W),
With a Southeast Compass Heading of approximately 150 degrees and a
Destination of Bay Bridge Airport, Kent Island, Maryland (38° 58’ N / 76° 19’ W)

(N means North of the Equator; W means West of Greenwich, England or the Prime Meridian)

Wind Direction Effect	**Wind Speed Effect**		
	None	Strong Headwinds from the East or Southeast Slow the Plane in the Baltimore Area and Push the Landing Site Westward of Kent Island	Strong Tailwinds from the North or Northwest Accelerate the Plane in the Baltimore Area and Push the Landing Site Eastward of Kent Island
None	**#1** **(Original Destination)** **(Airport)** **Bay Bridge Airport** **Kent Island, MD** **38° 58’ N** **76° 19’ W**	**#2** (Airport) Essex Sky Park Essex, MD 39° 15’ N 76° 25’ W	**#3** (Airport) Easton/Newnam Airport Easton, MD 38° 48’ N 76° 4’ W
Strong Crosswinds from the North or Northeast Blow the Plane Off Course in the Baltimore Area and Push the Landing Site Southward of Kent Island	**#4** (Water) Chesapeake Bay / Off Snug Harbor, MD 38° 51’ N 76° 29’ W	**#5** (Water) Patapsco River / Chesapeake Bay Off Fort Howard & North Point, MD 39° 21’ N 76° 45 W	**#6** (Water) Herring Bay Off Fairhaven, MD 38° 45’ N 76° 34’ W
Strong Crosswinds from the South or Southwest Blow the Plane Off Course in the Baltimore Area and Push the Landing Site Northward of Kent Island	**#7** (Water) Chester River Off Gordon Point, MD 39° 41’ N 76° 10’ W	**#8** (Airport) Breezecroft Near Chestertown, MD 39° 15’ N 76° 12’ W	**#9** (Airport) Ridgely Pelican Airport Near Ridgely, MD 38° 58’ N 75° 51’ W